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Discussion After the Speeches of Kent H. Hughes and Alan Nymark

QUESTION, *Professor King*: You outlined the technology policy of the United States, the ability of the government or the good will of the government to help. If I were somebody from outer space, I would ask you, thus far, what are the results of that? How do you test performance? And that helps sell it to the public too.

ANSWER, *Mr. Hughes*: That is a good question, it is one we have thought about, and one we are trying to do something about.

In some sense the whole test of our puzzle of many pieces, our competitiveness strategy, is growth and rising standards of living. That is a very long-term test. In the technology area we often face an equally complex measurement challenge. Take the Advanced Technology Program. We are not looking to make investments in very near term product development. Because it is a new program, we cannot show lots of clear results yet. We are, however, trying to measure the success of the innovations and their economic impact.

In isolated instances you have individual examples where the program has worked just as we like it to, in the high-risk area. It is turning an idea into an innovative product. And, we have seen rapid growth in the company in terms of job creation and profits.

There is an element of technology that is a little different than many other kinds of programs. If we were, for instance, to look back in ten years and see every one of our technology investments paying a high return, I suspect, then, we would not be taking the right kind of risks. That we would be, in fact, investing in the kinds of things that the market or individual companies would most likely have done themselves.

So you have got to look in a sense at the success of your scientific program just the way a company would have to if they expect a certain amount of failure, or the way a venture capitalist would where he or she is careful to look, not at the batting average, but at what baseball fans would call the slugging average.

Third, in the area of the manufacturing extension partnership program, again, we are trying to measure the impact on small businesses. We are not just measuring how many companies have been helped in a particular year. We are looking for the difference our work has meant in terms of economic success and the strength of that sector, that business, that individual firm. So we are thinking about those metrics and trying to be careful to measure as we go along.

QUESTION, *Professor King*: Do you have any comment on that, Alan? How do you measure performance in terms of the results?

COMMENT, *Mr. Nymark*: Well, I think the honest answer to that is that, typically, governments have not tried to do that at all, and we have no general statistical systems which allow us to do that.

Now, like Kent, we do evaluations of programs, however, those have in the past been evaluations done by bureaucrats who find it very self-serving to find tremendous impacts out there; lots of jobs created, and that helps them keep their jobs.

Your comment appears to be directed towards governments that see programs as the answer to innovation problems, and in that it appears to be the role, the appropriate role, in essence, it comes down to governments handing money to you in various programs. Now, we are getting sophisticated by saying, well, it has to be clusters of firms, it cannot be individual firms. It has to have strategies based on public/private sector agreements. There must be a long-term strategy in place and have corporate roles between them. I guess we have gone through those arguments, and we have found that there is really a very minimal role for government at all in those kinds of programs. I think that there is a large role for government in the kinds of programs Kent was talking about in the area of diffusion and networking and those sorts of issues. Now, you say how do you evaluate those kinds of programs? I do not know.

QUESTION, *Mr. Fay*: If we are benchmarking the commerce sections of Canada and the United States, it seems to me whether they spend seventy-three billion dollars in the United States or six or seven billion dollars in Canada, maybe that is in proportion to the population; but in terms of results, sometimes we look at it, it should be maybe trade balances. The commerce of trade balance in the United States is one hundred and fifty billion dollars and President Clinton says, fine, go ahead, more debt.

I just wondered how do you measure up the Commerce Department in terms of new product development that you sponsored? We have sold them overseas and we have really reduced the trade deficit.

ANSWER, *Mr. Hughes*: The trade deficit is something that we are concerned about. We have not eliminated the deficit, but we have attacked it in a fundamental sense. To the extent the trade deficit is linked to our savings rate, which in turn is linked to our fiscal deficit, our federal deficit. We have made real progress on the federal deficit. It is as low, relative to the size of our economy, as it has been in many years. It was, as you saw in 1993, an enormously painful effort. We have in place cuts coming in future years that will keep that budget deficit down. Do we need at some point to take more steps in that direction? Yes, we do.

In terms of moving more actively on the trade deficit itself, the near-term results have been much clearer in more effective trade promotion and trade advocacy. I think it is fair to say that during much of

the Cold War what we might refer to as geo-economics took a very distant second place in the United States to geopolitics. I think if you were to take aside some of our experienced trade negotiators like Gary Hufbauer and ask how hard they pushed to get into market X or market Y, they would say, "I worked very hard, but just as I was about to get some success, I got a call from the Secretary of State or someone on the geopolitical side and they said, "look, the relationship is too important, back off."

Where we have focused our attention on the best practices of the Europeans and the East Asians, we have made some real progress in terms of export sales and making ourselves a more competitive presence around the world. In terms of a particular innovation that you could trace to a recent commerce department program that in turn has made a major impact on export sales, most of our programs are too new. But certainly the commitment that the country has to an overall climate of innovation will yield large, long-term results.

QUESTION, Professor King: One of the questions that consumed me in terms of my thinking on the subject is interest rates. Do you have any comment on the effect of rising interest rates on innovation? Are people required to take chances? In other words, it is easy to say better when they are low, harder when they are high, but is there any concrete evidence on this subject as to what are the effects of interest rates going up on innovation? Kent, would you tackle that?

ANSWER, Mr. Hughes: I have read lots of studies linking innovation to economic growth and lots of studies talking about how hurdle rates or internal interest rates used by corporations are higher in the United States than they are in some other economies. I am not sure I read a study that specifically links overall societal interest rates to innovation.

In part, companies that are technology-intensive or technology-driven increasingly look at those investments as part of their core competence so they are not quick to cut them. But I think the internal hurdle rates of companies have to be influenced by what is happening in the overall interest rate environment.

In particular in the United States where we tend to rely on, let us call it, the Silicon Valley model where you have got lots of small start-up companies with a good idea, they often have difficulty getting access to capital. Rising interest rates are not only a problem themselves, but they are often a proxy for capital availability. So I am sure there is a link.

COMMENT, Professor King: I would like to agree with Kent from having worked internally in the company. The hurdle rates get to be harder to get something new done.

QUESTION, Mr. Hufbauer: You recall that David Crane cited the abysmal total factor productivity statistics for Canada, and one

could say the same for the United States. However, when one breaks it down, we have the internationally traded sector, natural resources and manufactured goods where productivity has been very high, and then we have the services where at least in the United States services productivity growth has been pretty low, however you search at it.

I am wondering if in Canada there has been any uptake in productivity growth in all these innovations, especially the information services, or whether it is flattened as far as the eye can see.

For Kent, I am wondering, what is your outlook — try to take off your government hat for a moment. We have all those weapons labs, we have a lot of them, and there is a lot of talk about trying to convert these to commercial use in one way or another, but you know the academic literature is pretty skeptical of the conversion. I wonder what your feeling is on that issue.

ANSWER, *Mr. Nymark*: That is quite a large question asking what is the relationship between open markets and total-factor productivity particularly in a knowledge-intensive world.

And I guess there is a strong consensus on conversion theory in terms of growth rates and TFP among the industrialized countries. We may well be seeing in the future all of the industrialized countries not quite matching the performance they did over the last fifty years. I just spent a week in three conferences which I sponsored on the implications for knowledge-base growth and whether, in fact, there really is something more structural than long-term taking place.

Are we in the third most profound structural change in this millennium or are we not? Are we witnessing the telecommunications and information highway revolution, something the equivalent of the agricultural, or the industrial revolution? Quite clearly those who like to measure these things will be seeing for many years into the future. The jury is still out.

I think there is, however, increasingly qualitative analysis which would suggest that we really are in one of these transition periods that is going to be very profound in terms of long-term implications for most of our economies. And in the course of that transition, some of the typical relationships both at the national level between TFP and expenditures on R&D, for example, and at the firm level the relationship between skills and capital expenditures and R&D expenditures may be changing rather more fundamentally than we had thought in the past.

There is a very large debate between the fallout on jobs between Europe and North America and the difference in the way we handle largely market systems surrounding that and why we find relatively lower job fallout in North America vis-à-vis Europe.

I think these are just extremely difficult questions to answer. I do not have a hard answer on them. I know the short answer is that in a country like Canada we see a ten percent rate of unemployment out as

far as we can forecast, and in Europe they see a greater than ten percent rate of unemployment out as far as they can forecast, and politically this is unacceptable.

COMMENT, *Mr. Hughes*: I will be very brief on the labs.

We do, in fact, have an enormous resource in our national laboratories. There are, depending on how you count them, perhaps as many as 720 national laboratories. They have collective budgets of more than twenty billion dollars a year. The energy labs which are probably the best known, including Los Alamos, Sandia, and Lawrence-Livermore, themselves take several billion dollars a year. There has been a lot of discussion about how that Cold War resource might be, in part, turned to other purposes.

I know that Secretary O'Leary has been giving a lot of thought to just that question. She has recently received recommendations from the commission headed by Bob Galvin, the retired CEO of Motorola. The Galvin report suggested that the labs continue to focus on their historic missions, that perhaps one or two of the labs might be privatized in some way. It is difficult for them to shift their mission toward becoming strictly focused on industry.

I think if you would talk to many parts of the private sector, they would be even more skeptical that the labs can change their culture. That is, you have labs which have had one mission and one customer, National Security and the Department of Defense, for almost their entire existence, and to get them to think in terms of toasters one week and semiconductors the next might be very difficult.

I do not really work on the energy labs in great detail myself. My own sense is that some of the labs have really been quite surprisingly agile and have formed a number of useful partnerships with industry. For Sandia, Los Alamos, and Lawrence-Livermore I can think of specific examples. So it may be that eventual practice will be somewhere in between the traditional mission focus and the shift toward industry with perhaps some of the laboratories changing their nature more fundamentally.

QUESTION, *Professor Shanker*: Mr. Hughes pointed out what we all know; namely, that industry is recognizing that the performance of our high school graduates is rather lacking, and you mention one or two things that the government is doing, our government, the United States government, is doing such as suggesting national standards for math, science, English, and so forth.

There is another part of it that it seems to me you did not talk about, and that is it strikes me, as an academic, that fewer and fewer of our students are interested in going into science and math, and yet we talk about the need for these great ideas for technical development.

What do we do about this diminishing pool of qualified mathematicians and scientists who are at the core of the people in the future

who will make the technological innovation? Any thoughts from either of our guests?

ANSWER, *Mr. Nymark*: That is a good question. I will start off. Just a couple of comments. One is that I think that our schools, kindergarten to grade 12, are not performing very well in either country. I think also that there is a tremendous diversity in performance.

One innovation that we are looking at — and the role of the Federal Government in Canada is not strong in this area — one of the areas that we are looking at which might be of assistance is the role of the information highway in respect to what happens in the schools, both kindergarten to 12th grade and in the university system.

We have a program in Canada. It is a government-sponsored program, which will link 17,000 schools in the kindergarten to 12th grade field by the electronic highway within another two years. We cannot afford to do this. We cannot afford to have the Federal Government spend the money and do this, so we are looking at providing incentives in the system so that schools want to get on the information highway, and so we are in the game. It is a bit of a strange game for us in the industry department, but it is interesting that it took the industry department to generate the kind of competition among schools for content that you would have on the information highway, and we are finding that there is tremendous initiative and creativity out there in our schools. They are putting onto the highway just absolutely fabulous content.

A high school in the Northwest Territory has now got access to the same content and best practice teaching skills as a high school in the best suburbs of Toronto. That is quite a major leap forward in terms of access to facilities, content, et cetera.

Another thing that we are focusing on is the issue of why are the kids not interested? What does that say about where we will be in the innovation game in twenty years, at the end of the mandate, or some other time that might be imposed on us?

One particular thing that we focused on in that respect is the gender differences, and what we have found through experimentation in pretty small-scale programming in Canada over the last five years is that women entering math, engineering, and science in universities are very susceptible to image and culture and the environment that you provide. A government can assist in that and data shows very dramatic responsiveness to attempting to change those very, very, very soft environmental factors.

COMMENT, *Mr. Hughes*: Much of what we are doing in this area does parallel some of the remarks that Alan made on trying to link schools to the information highway. Several departments have been working on a learning technology initiative that was unveiled by Vice President Gore in February. Our vision is based on some of the

results you can achieve when an individual tutor works with a student. It is what I gather professional educators often refer to as the two sigma solution; that is, where you have an individual child working with a tutor you move those results two sigmas to the right in terms of the result, and you have a very narrow distribution around that much improved performance. The hope is that learning technologies might be able to approximate that result.

Much like Canada, we are trying to make the most of interagency strength and cooperation. In this case not only labor and education, which would be pretty obvious alternatives, but Commerce and the Department of Defense, which in the United States does an enormous amount of sophisticated training.

You ask an even more fundamental question because all those things are still in on the supply side. There are inputs, there are better computers, better classrooms, and so forth. What about the motivation of the child?

I have been for a number of years involved with a group called U.S. First. It is really the brainchild of Dean Kamen, who is an inventor and entrepreneur in New Hampshire. He is bound and determined to get American kids excited about math and science and, in fact, it has triggered a similar group that is now starting up in Canada.

His vision has led to a national robot contest. A high school is partnered with engineers from universities or companies. Each team receives the same carton of parts and a set of rules for the game. The robot design depends on the parts and the strategy for winning a ball game. Dean's goal is to make this as exciting as a Final Four basketball game, so much so that the major corporate sponsors which pay a million dollars a minute for the Super Bowl will at some point be sponsoring the national robot contest. The contest has grown and grown and, now in its fourth year, was hosted by the Disney Corporation in Orlando. It is one of the very few efforts that focuses on motivation.

I think it may be that we also have a cultural hurdle in the United States. If you watch a lot of our sitcoms, which my kids usually insist that I do, the bright child on the show almost always has goggle glasses and is dressed inappropriately. If they know the answer to something, the laugh track goes up as if it is bizarre a child would know the answer to what is happening at NASA or something similar. We have to go after that basic culture.

